FEATURE

Protecting the Next Century's Environment—
The Navy's New Shipboard Oily Waste Membrane Polishing System

by Anthony Nickens and Joe Pizzino

NAVSEA, with support from the Environmental Protection, Safety and Occupational Health Division (N45) within the Office of the Chief of Naval Operations (CNO), has developed a shipboard oily-waste "polishing" system based on ultrafiltration membranes. This new system will allow surface ships equipped with Oil/Water Separators (OWSs) and Oil Content Monitors (OCMs) to consistently meet the current oil discharge limit of 15 parts per million (ppm). These polishing systems will be installed initially on new *Arleigh Burke* (DDG 51) Class destroyers, starting with DDG 89.

Environmental Requirement

Navy (i.e., CNO) policy on surface ship oily discharges reflects the requirements of the Clean Water Act, the Act to Prevent Pollution from Ships, and the International Convention for the Prevention of Pollution from Ships. OPNAVINST 5090.1B states that "...Navy ships equipped with OWS and OCM shall attempt to limit oil and oily discharges to 15 ppm of oil worldwide."

and they continue to be installed on new-construction and existing ships.

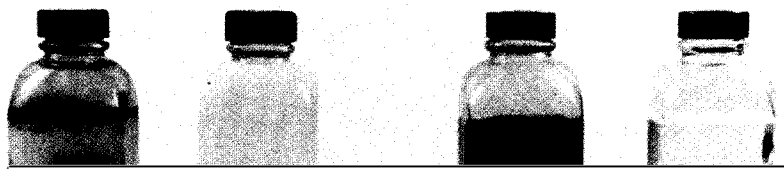
Problem

The Navy's OWS was designed for 15 ppm oil output based on steam-propulsion ships with bilgewater characteristics prevalent in the early 1970s. The current OWSs are very effective in removing bulk oil from the influent, but on certain ships they do not consistently and reliably reduce the residual oil concentration down to the 15 ppm requirement. This is because ships have changed significantly over the last twenty years. In particular, gas-turbine propulsion has become the norm, resulting in reduced bilgewater generation rates. The drier bilges on newer surface ships result in significantly higher concentrations of oil and contaminants [i.e., aqueous film-forming foam (AFFF), detergents, and other oil-emulsifying substances] in the bilgewater. These conditions degrade the performance of OWSs and OCMs and make it increasingly difficult to remove trace amounts of oil.

New Polishing Technology

NAVSEA determined that a secondary treatment system for oily waste located downstream of the existing OWS would be the most effective and efficient approach for producing oily discharges that consistently meet existing discharge restrictions. After an extensive review of technologies that might

SHIPBOARD ULTRAFILTRATION MEMBRANE POLISHING SYSTEM



be suitable for OWS effluent polishing, NAVSEA selected membrane ultrafiltration as the most promising technology for shipboard application.

NAVSEA directed the development

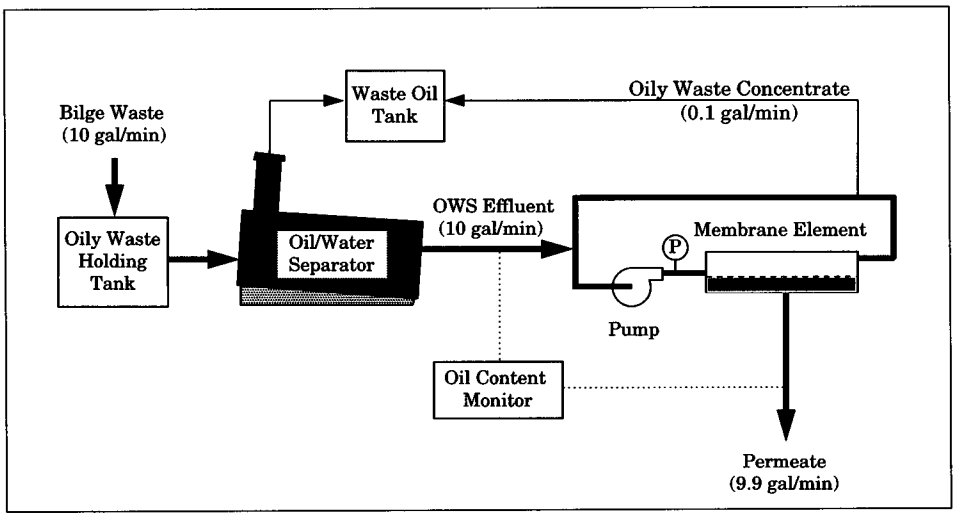


Figure 1. Diagram showing how oily waste is treated using the Oily Waste Membrane Polishing System. [Note: The Membrane Polisher is a step that has been *added* to the processing of oily waste; nothing in the existing system has been replaced.]

allowing water and dissolved matter to pass through a semi-permeable ceramic membrane while preventing the passage of relatively large suspended particles (e.g., oil droplets). Particles are excluded based on their physical and chemical interactions with the membrane surface as well as on their size. The oil and other impurities retained by the membrane are carried off in a concentrated stream. This eliminates the need to use and frequently replace filter cartridges. The tendency for particles to accumulate on and block (i.e., foul) the membrane surfaces can be effectively corrected during operation.

The polisher system weighs 2,500 pounds, occupies 25 square feet of deck space, and is 6 feet high. The heart of the polisher system is a set of three cylindrical ceramic membranes connected in a series. Each membrane and its housing is a ready-to-use, easily-replaceable unit that will last over 300 operating hours between maintenance actions. A combination of cold water lay-up (during system shutdown) and hot water flushing will be used to minimize the effects of membrane fouling. The PLC will fully automate the system and will link its operation to that of the OWS.

Benefits

The use of this oily-waste polishing system will have significant environmental, operational, and other benefits:

* By ensuring compliance with existing oil discharge restrictions, Navy surface ships will enjoy maximum operational flexibility and will not have to limit operations within certain bodies of water because of concerns about oily discharges.
* Where the in-port operation of the polishing system is allowed, the cost of oily waste offload and shoreside disposal can be avoided.
* The risk and extent of potential oil-related pollution from Navy surface ships will be reduced, thereby reducing the risk of regulatory violations and embarrassing incidents.
* The Navy's public image will be enhanced and Sailors can feel confident that the Navy is leading the maritime community in protecting the marine environment.

Status

The polisher technology will continue to be operated aboard ship through Fiscal Year 1998. During this time, system size will be reduced, operating and maintainability enhancements will be explored, and technical documentation and other logistics support will be finalized.

The oily waste polishing system is scheduled to be installed on DDG 89 and follow-on ships of the *Arleigh Burke* Class. A system performance specification has been prepared to support the acquisition of these systems.

The Future

In addition to installation on new *Arleigh Burke* Class ships, the polishing system will be considered by CNO as a potential backfit option for existing surface ships where appropriate. NAVSEA is also in the early stages of developing an advanced OCM that can accurately and reliably measure oil concentrations in the 5–15 ppm range to support new shipboard oily waste control systems.

Additional Information

For more information about the shipboard oily-waste polishing system, contact:

• Anthony Nickens, Shipboard Waste Management RDT&E Program Manager, NAVSEA 03R16; DSN: 703-332-0706; commercial: 703-602-0706 x424; fax: 703-602-6290; e-mail: NICKENS_ANTHONY@HQ.NAVSEA.NAVY.MIL
• Joe Pizzino, Shipboard Waste Management RDT&E Program Manager, NAVSEA 03R16; DSN: 703-332-0706; commercial: 703-602-0706 x410; fax: 703-602-6290; e-mail: PIZZINO_JOE@HQ.NAVSEA.NAVY.MIL

Anthony Nickens and Joe Pizzino are NAVSEA's Program Managers for Shipboard Waste Management Research, Development, Testing, and Evaluation (RDT&E) within the Ship Research, Development and Standards Group (SEA 03R).